Ref 1

⑲ Japan Patent Office ⑪ Patent Publication No.

⑫ **Patent Publication (B2)** Sho 57-43220

(51) Int. Cl.[3]	Identification symbol	Reference number in the JPO	(22) (44) Published date:
A 23 K 1/18	102	7803-2B	Sept. 13, 1982

Number of Invention: 1

(4 pages in total)

(54) Feed for Marine Echinozoans

(21) Application No.: S50-58619
(22) Filing Date: May 19, 1975
(65) Unexamined
Publication No.: S51-135296
(43) November 24, 1976

(72) Inventor: Ryusuke Azuma
249, Kasumidai, Hodogaya-ku, Yokohama-shi
(72) Inventor: Tadashi Nakamura
1-24-25, Teraya, Tsurumi-ku, Yokohama-shi
(72) Inventor: Tomio Higuchi
1264-8, Shibusawa, Hadano-shi
(71) Applicant: Nosan Corporation
2-2, Shinurashima-cho, Kanagawa-ku, Yokohama-shi

(57) CLAIMS

1. A feed for marine echinozoans in the form of flat plates having a thickness of 5 mm or less comprising: hydrating various raw materials suitable for a feed for marine echinozoans, extruding a mixture thereof through the hole of a die under pressure, cutting and press-molding.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to an artificially blended feed for useful species of Echinodermata, namely useful marine animal species ordinarily referred to as echinozoans, and an object thereof is to provide an artificially blended feed for

echinozoans that instantaneously settles to the bottom of a body of water in a shape suitable for the feeding behavior of echinozoans, retains the shape thereof for 48 hours or more on the bottom of a body of water, causes little contamination of water quality, is inexpensive, and has satisfactory storageability.

Although the dietary and feeding behavior of marine echinozoans has conventionally consisted of the capturing of plankton by pluteus larva while in a planktonic existence, after having migrated to a bottom-dwelling existence, they are known to be characterized by ingestion of adhered diatoms by licking, ingestion of brown algae, green algae, red algae and other typical forms of marine algae, as well as minute organisms adhering to rock surfaces in the water, extremely slowly and over the course of time once they have reached a certain shell diameter such as about 3 mm or more in the case of sea urchins, and since they move through water by moving their spines, it is not possible for these organisms to aggressively ingest food floating in the water in the manner of typical fish and crustaceans by swimming, but rather passively ingest food that has settled to the bottom.

On the other hand, considerable emphasis has recently been placed on the artificial fingerling production and breeding of useful species of echinozoans consisting primarily of sea urchins accompanying the development of the fish farming industry, and production and breeding are becoming increasingly active due to progress made in technical research in this field.

Since live algae had previously been commonly supplied as feed for echinozoans accompanying increases in the amounts of echinozoans bred in this manner, there has been a prominent shortage of feed algae, thus resulting in the need for an artificially blended feed and calls for the development thereof. However, an artificially blended feed for echinozoans has not yet to be developed.

Therefore, as a result of extensively conducting various studies on artificially blended feeds for echinozoans, the inventors of the present invention found that it is essential for artificially blended feed to satisfy the conditions listed below in view of the feeding characteristics of marine echinozoans.

(1) Since echinozoans search the ocean bottom while crawling along by moving their spines and ingest food extremely slowly over the course of time, the shape of the feed should satisfy these feeding characteristics.

(2) Since echinozoans feed during the night over a long period of time, the feed must be able to retain its shape for at least 48 hours in water.

(3) The feed is required to instantaneously sink to the bottom immediately after being given.

(4) Since feeding by echinozoans is considerably affected by the oxygen content and ammonia nitrogen content of the breeding water, elution of feed and residual feed must not contaminate the water quality.

(5) The raw materials that compose the feed must be commonly used raw materials that can be constantly acquired in abundance, and the finished feed must have storageability and be economical.

The inventors of the present invention then found that a method for satisfying these conditions consists of hydrating various types of raw materials suitable for feed for echinozoans, extruding a mixture thereof through the hole of a die under pressure, cutting and press-molding into a flat shape, thereby leading to completion of the present invention.

Namely, the present invention is a feed for marine echinozoans in the form of flat plates having a thickness of 5 mm or less comprising: hydrating various raw materials suitable for a feed for echinozoans, extruding a mixture thereof through the hole of a die under pressure, cutting and press-molding.

The following provides a detailed explanation of the present invention.

The feed raw materials for marine echinozoans used in the present invention can be suitably selected according to the type of target echinozoan or degree of growth thereof from among animal protein sources such as fish meal, lactocasein and animal flesh protein; vegetable protein sources such as corn gluten meal, defatted soybeans and yeast; hydrocarbon sources such as wheat, barley, corn, milo and defatted rice bran; oil sources such as fish oil, vegetable oil and animal oil; binders for facilitating shape retention; vitamins and minerals for nutritional supplementation; flavorings and other substances for promoting ingestion; polyvalent alcohols such as sorbitol or propylene glycol for imparting plasticity and prevention of degradation; and other raw materials.

Production of the echinozoan feed of the present invention is carried out in the manner described below.

First, the aforementioned raw materials are hydrated to a moisture content of

20 to 50% followed by mixing to homogeneity. The reason for making the moisture content 20 to 50% at this time is that, if the moisture content is less than 20% in the subsequent high-pressure treatment, the moisture ends up being too low, fluidity required for extrusion and molding treatment is unable to be obtained, the cylinder and die hole of the extruding machine become clogged, scorching occurs due to the heat of friction, or excessive pressure is applied resulting in prominent swelling. In addition, if the moisture content exceeds 50%, the fluidity of the raw materials becomes excessively high, thereby preventing the pressure from rising in the cylinder and preventing the obtaining of a highly pressurized state.

Next, the mixture of the raw materials is charged into the cylinder from the hopper of the extruding machine followed by kneading at a constant temperature of, for example, 80 to 120°C at a high pressure of, for example, 20 to 100 kg/cm^2, extruding through a die hole and cutting into strips with a cutter.

At this time, although the extruded intermediate product swells due to pressurization and the temperature rise caused by pressurization, by adjusting the amount of water added to the raw materials and the degree of cylinder cooling, swelling is preferably made to be about 1.0 to 1.3 times by volume.

If the degree of swelling exceeds 1.3 times by volume, the ability to settle to the bottom of water becomes inferior even if the product is flattened in the subsequent step, while if the degree of swelling is less than 1.0 times by volume, the product ends up disintegrating due to swelling in water.

Examples of extrusion molding machines that can be used in the aforementioned step include extruders and puff machines, and the shape of the die hole and diameter and length of the intermediate products cut with a cutter may be suitably selected according to the type of echinozoan to be fed and the degree of growth thereof.

Following extrusion molding and cutting, the surface of the intermediate products is dried by passing through a dryer to reduce the moisture content to 15 to 35% in the case of semi-moist feed, or 15 to 20% in the case of dry feed. If dried excessively at this time, the intermediate products are crushed or cracks form in the subsequent flattening step, while if the degree of drying is inadequate, the intermediate products end up adhering to the flattening press causing a decrease in flattening efficiency, thereby making this undesirable.

Next, the dried intermediate products are supplied to the flattening press where they are flattened by press molding to a thickness of 5 mm or less. The flattened products have an external shape in the form of flat plates, while the inside has a dense porous structure. Although any type of flattening press may be used for the flattening press at this time provided the pores of the swollen products are pressed to push down and the products are flattened to a thickness of 5 mm or less, a set of rotating rollers is used most preferably.

Moreover, the flattened products are preferably dried again, if necessary, to adjust to a moisture content of 15 to 35% in the case of semi-moist feed or to a moisture content of 15% or less in the case of dry feed.

The echinozoan feed of the present invention obtained by the production process described above does not require conditions similar to live algae such as the addition of live algae in the form of nutrient sources or flavor enhancers, or a moisture content similar to live algae (50 to 60% or more).

Since the echinozoan feed of the present invention is the result of flattening a swollen product into flat plates having a thickness of 5 mm or less, it immediately settles in water, retains its shape for 48 hours or more on the bottom, closely matches the feeding characteristics of echinozoans, allows useful species of echinozoans, and particularly sea urchins (including northern species consisting of short-spined sea urchin and northern sea urchin as well as southern species consisting of green sea urchin, red sea urchin and hard-spined sea urchin), to adequately ingest the feed and exhibit prominent growth if given after having migrated to a bottom-dwelling existence, promotes satisfactory growth of the edible portion in the form of the reproductive organs, and exhibits extremely little disintegration of feed or residual feed, thereby enabling stable proliferation and breeding without causing contamination of the breeding water.

Moreover, in comparison with live algae, handling of feed requires considerably less labor and feed can be stored easily.

Although the following provides a more detailed explanation of the present invention through examples thereof, the present invention is not limited to these examples.

Example 1

After adequately mixing the raw materials in the blending ratios shown in Table 1 with a mixer, the raw material mixture was hydrated and adjusted to a moisture content of 30 to 35%.

Next, the raw material mixture was loaded into an extruder and extruded into rods through a die hole on the end of the extruder with a screw at a pressure of 80 kg/cm^2, and the rods were cut with a rotary cutter attached to the end of the die followed by air drying to somewhat dry the surface of the feed. Next, the semi-moist pellets were press to a thickness of about 2 mm with a set of rotating rollers to obtain two types A and B of echinozoan feeds of the present invention.

Table 1

Name of raw material	Feed A of present invention	Feed B of present invention
White fish meal	30.0%	20.0%
Green laver powder	-	20.0%
Corn gluten meal	-	15.0%
Defatted soybean	19.0%	-
Wheat flour	30.7%	13.7%
Vital gluten	10.0%	5.0%
Propylene glycol	2.0%	10.0%
Sorbitol	2.0%	10.0%
Potassium sorbate	0.3%	0.3%
Vitamin mixture*1	2.0%	2.0%
Mineral mixture*2	4.0%	4.0%

*1,*2: Halvar mixtures (1957)

The two types A and B of feeds obtained in the manner described above were fed to naturally caught hard-spined sea urchins having a mean shell diameter of 1.0 cm and mean body weight of 0.5 g to conduct a growth test.

In addition, a growth test was also conducted in the same manner by feeding the sea urchins green laver of live algae to serve as a control. 500 sea urchins were used in each group, and the sea urchins were cultivated for 150 days. The cultivation method consisted of running filtered raw seawater into three ponds measuring 2 cm x 1 m x 0.5 m and aerating the water.

The results were as shown in Table 2. The results of cultivation were extremely favorable, thus clearly demonstrating that the feed of the present invention is superior as a feed for echinozoans.

Table 2

		Feed A of present invention	Feed B of present invention	Green laver
At start:	No. of sea urchins	500	500	500
	Mean shell diameter (cm)	1.0	1.0	1.0
	Mean body weight (g)	0.5	0.5	0.5
At completion:	No. of sea urchins	482	476	488
	Mean shell diameter (cm)	2.6	2.3	2.1
	Mean body weight (g)	8.6	8.0	7.8
Mean weight gain (g)		8.1	7.5	7.3
Daily growth rate (%)		2.60	2.52	2.48

Example 2

After adequately mixing the raw materials at the blending ratios shown in Table 3, the raw material mixtures were hydrated followed by adjustment to a moisture content of about 30%. Next, the raw material mixtures were loaded into an extruder and pressed through the cylindrical hole of a die on the end of the extruder with a screw at a pressure of 80 kg/cm^2 while maintaining the temperature inside the cylinder at 120°C, followed by cutting into the shape of plates measuring 7 cm long and 3 cm wide with a rotary cutter attached to the end of the die. Next, after drying the feed to a moisture content of about 17% with a dryer, the feed was pressed with a set of rotating rollers followed by additional air drying by passing through a hot air dryer to a moisture content of about 10% to obtain feeds C and D of the present invention.

Table 3

Name of raw material	Feed C of present invention	Feed D of present invention
White fish meal	30%	-
Defatted soybean	17%	30%
Corn gluten meal	10%	30%
Wheat flour	33%	30%
Vitamin mixture *1	2%	2%
Mineral mixture *2	6%	6%
Calcium carbonate	2%	2%

*1,*2: Halvar mixtures (1957)

The two types of feeds C and D obtained in the manner described above were

fed to naturally caught short-spined sea urchins having a mean shell diameter of 1.0 cm and mean body weight of 0.5 g to conduct a growth test.

In addition, a growth test was also conducted in the same manner by feeding the sea urchins green laver of live algae to serve as a control.

500 sea urchins were used in each group, and the sea urchins were cultivated for 75 days. The cultivation method consisted of running filtered raw seawater into three ponds measuring 2 m x 1 m x 0.5 m and aerating the water.

The results are as shown in Table 4. The results of cultivation were extremely favorable, thus clearly demonstrating that the feed of the present invention is superior as a feed for echinozoans.

Table 4

		Feed C of present invention	Feed D of present invention	Green laver
At start:	No. of sea urchins	500	500	500
	Mean shell diameter (cm)	1.0	1.0	1.0
	Mean body weight (g)	0.5	0.5	0.5
At completion:	No. of sea urchins	488	490	480
	Mean shell diameter (cm)	1.8	1.7	1.7
	Mean body weight (g)	3.5	3.3	3.3
Mean weight gain (g)		3.0	2.8	2.8
Daily growth rate (%)		2.61	2.57	2.55

Example 3

A growth test was conducted by feeding feed A of the present invention of Example 1 and feed C of the present invention of Example 2 to naturally caught green sea urchins having a mean shell diameter of 3 cm and mean body weight of 12 g.

In addition, a similar growth test was conducted in the same manner by feeding sea urchins green laver of live algae to serve as a control.

30 sea urchins were used in each group, and the sea urchins were cultivated for 90 days. The cultivation method consisted of running raw seawater into three ponds measuring 1 m x 1 m x 0.5 m and aerating the water.

The results are as shown in Table 5. The results of cultivation were extremely favorable, thus clearly demonstrating that the feed of the present invention is superior as a feed for echinozoans.

Table 5

		Feed A of present invention	Feed C of present invention	Green laver
At start:	No. of sea urchins	30	30	30
	Mean shell diameter (cm)	3.0	3.0	3.0
At completion:	No. of sea urchins	27	28	28
	Mean shell diameter (cm)	3.5	3.3	3.5
Weight ratio of reproductive organs to body weight at completion		12.3	12.1	12.7